Space Weather Technical Forecast

Issued on Thursday, 29 February 2024 at 13:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Ongoing risk of further M or X-Class flares from AR3590 in the northwest.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Moderate during the last 24 hours with a long period M-flare, reaching M1.5 at 28/1854 UTC from AR3590. There are seven sunspot regions on the disc. AR3590 remains the largest and most significant potential flare source, with a complex magnetic structure and large delta spot persisting within its intermediate spots. This spot also has a large amount of associated flux, increasing the potential for larger flares, should any occur. The other regions are smaller, however AR3595 has seen ongoing growth with latitudinal spread, becoming a more mature bipolar spot with recent small scale mixed polarity development within the central portion. AR3596 and AR3597 are both much smaller, but have a N-S aligned magnetic structure which could produce increased instability.

A CME from AR3590 associated with the long period M-flare has been analysed, and is expected to pass ahead of Earth with no significant impact. A second southward directed CME from the region of AR3591 has been analysed and we await model output.

Solar Wind / Geomagnetic Activity: Solar winds as recorded by ACE and DSCOVR at L1, showed a minor enhancement - perhaps some limited influence from CH03/-. Wind speeds were mostly slightly elevated, varying between 380-460km/s with a slowly declining trend. Density was below average throughout. The interplanetary magnetic field, Bt, was weak throughout, below 5nT. The north-south component, Bz, varied weakly between +4/-4nT. Phi angle was negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background levels with the associated 24 hour fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 29/0000UTC was 1.48e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with isolated M-class flares likely. There remains a slight chance of further X-class flares from AR3590 throughout.

Solar Wind / Geomagnetic Activity: There are three recent CMEs which are all most likely to miss Earth, but with a risk of some glancing influence, most likely on Day 3 (02 Mar), perhaps extending into Day 4 (03 Mar). Solar winds may become slightly elevated in the near term, possibly due to some weak interaction with the high speed stream from CH03/-, but otherwise no further notable enhancements are expected with any other coronal holes on the disc thought unlikely to influence Earth, and winds in the absence of CME enhancement expected to remain generally at background.

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Geomagnetic activity is therefore forecast to be mostly Quiet, perhaps increasing to give Unsettled to Active intervals with any CME influence on Days 3 and 4 (02-03 Mar), with a Slight Chance of an isolated G1 Minor Geomagnetic storm interval.

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is likely to stay at background levels, but with a slight chance of rising above S1 levels in response to any notable flares from AR3590, due to its position in the western disc. GOES16 high energy electron flux is expected to remain at background levels with the associated 24hr fluence remaining well below the Active threshold throughout.

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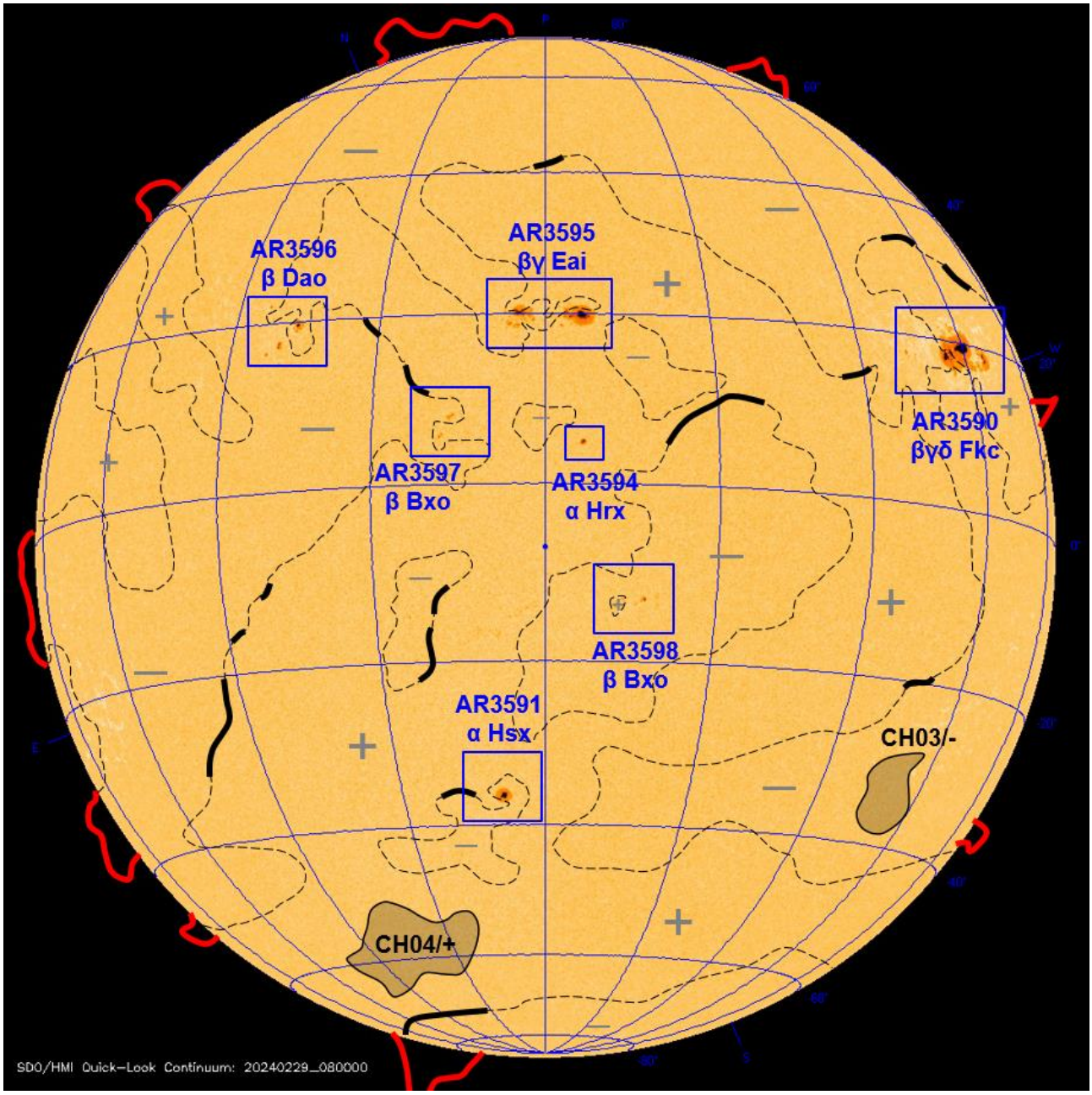
Figure 1. Solar Analysis Valid 29/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are three recent CMEs which have been considered for any Earth directed influence - one from 27 Feb and two from 28 Feb. All are thought most likely to miss Earth, but with a risk of some glancing influence, most likely later on Day 3 (02 Mar), perhaps extending into Day 4 (03 Mar).

Solar winds may become slightly elevated once again, possibly due to some weak interaction with the high speed stream from CH03/- in the near term, but otherwise no further notable enhancements are expected with any other coronal holes on the disc thought unlikely to influence Earth, and winds in the absence of CME enhancement expected to remain generally at background.

Geomagnetic activity is therefore forecast to be mostly Quiet, perhaps increasing to give Unsettled to Active intervals with any CME influence on Days 3 and 4 (02-03 Mar), with a Slight Chance of an isolated G1 Minor Geomagnetic storm interval.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
27/1856	Partial	Filament	South Centre	450 km/s	02/2100UTC	Glancing blow possible
28/1335	Partial	Filament	Southeast	750 km/s	02/1200UTC	Glancing blow possible
28/1743	Partial	Uncertain	Northeast	460 km/s	02/1800UTC	Glancing blow possible

Figure 2: Latest MOSWOC ENLIL Ensemble output

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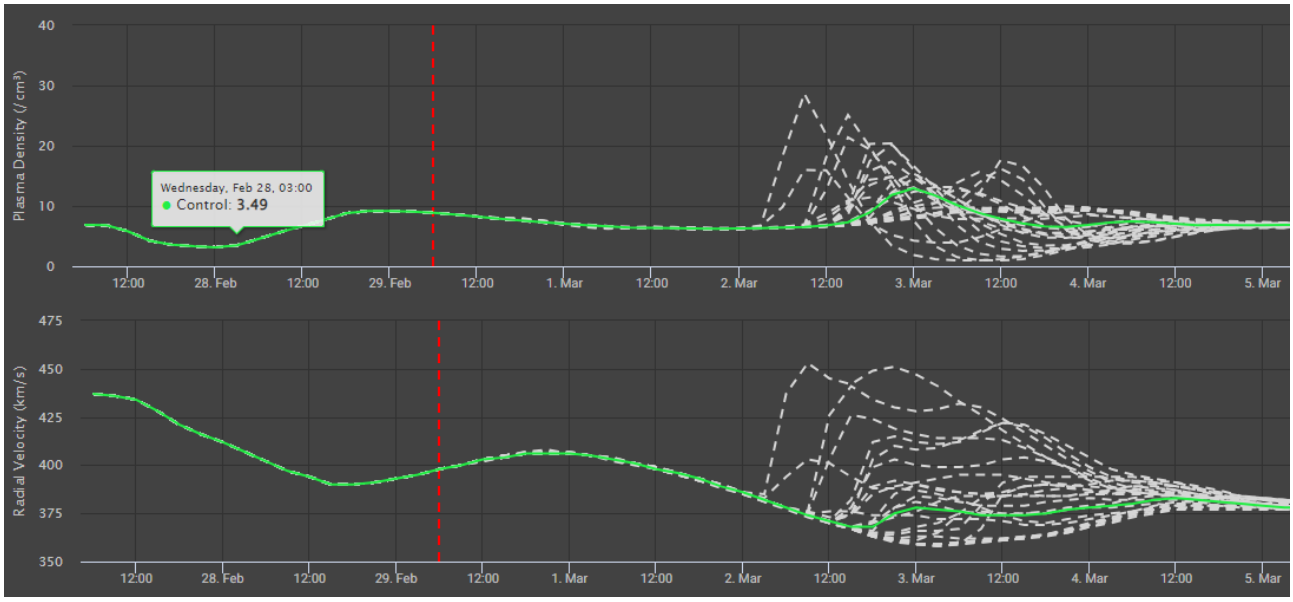

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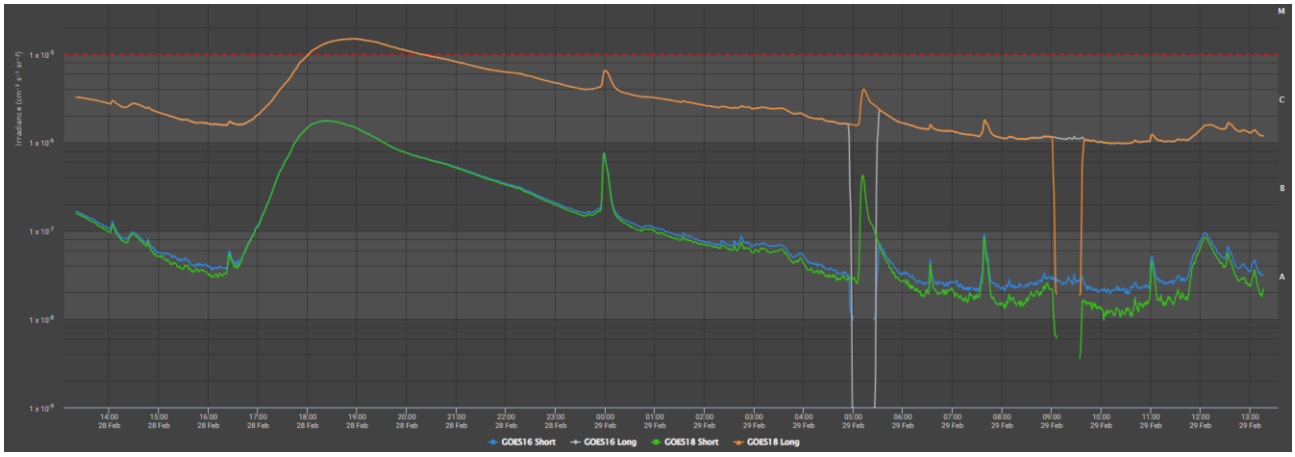
Radio Blackouts - X-Ray Flares:
AR3590 remains the largest and most significant potential flare source. While recent activity from this region continue to be reasonably low, a complex magnetic structure and large delta spot persists within its intermediate spots. Large amount of associated flux with this region maintaining the potential for larger flares, should any occur with a persistent slight chance of further x-flares continuing from the region. The other regions are smaller, however AR3595 has seen ongoing growth with latitudinal spread, becoming a more mature bipolar spot with recent small scale mixed polarity development within the central portion. All other regions smaller or simpler by comparison, contributing little to the overall flare risk.

Further Isolated M-class flares are considered likely, with a slight chance of X-class flares. The strongest flares are most likely to be from AR3590. AR3590 will rotate off the disc late on Day 3 (02 Mar), with the risk of flares declining through Day 4 (03 Mar) as it rotates away from the limb, though perhaps bolstered by oncoming active regions rounding the east limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	50
Very Active	R3 to R5 X Class	No	20	20	20	15

Figure 3: Latest 24hr GOES16/18 X-ray trace



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Solar Radiation Storms - (High Energy Protons):
GOES-18 proton flux is currently at background levels, and is likely to remain so through this period. However, there is a slight chance of enhancement as AR3590 moves across the western disc, with this region now in a prime location for any large flares to also result in an observable proton enhancement at Earth. This is low confidence however, due to the current relatively low activity from the region. Although AR3590 rotates off the disc late on Day 3 (02 Mar), the risk of proton events remains until it is well over the west limb, by around a further 3 days.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	15
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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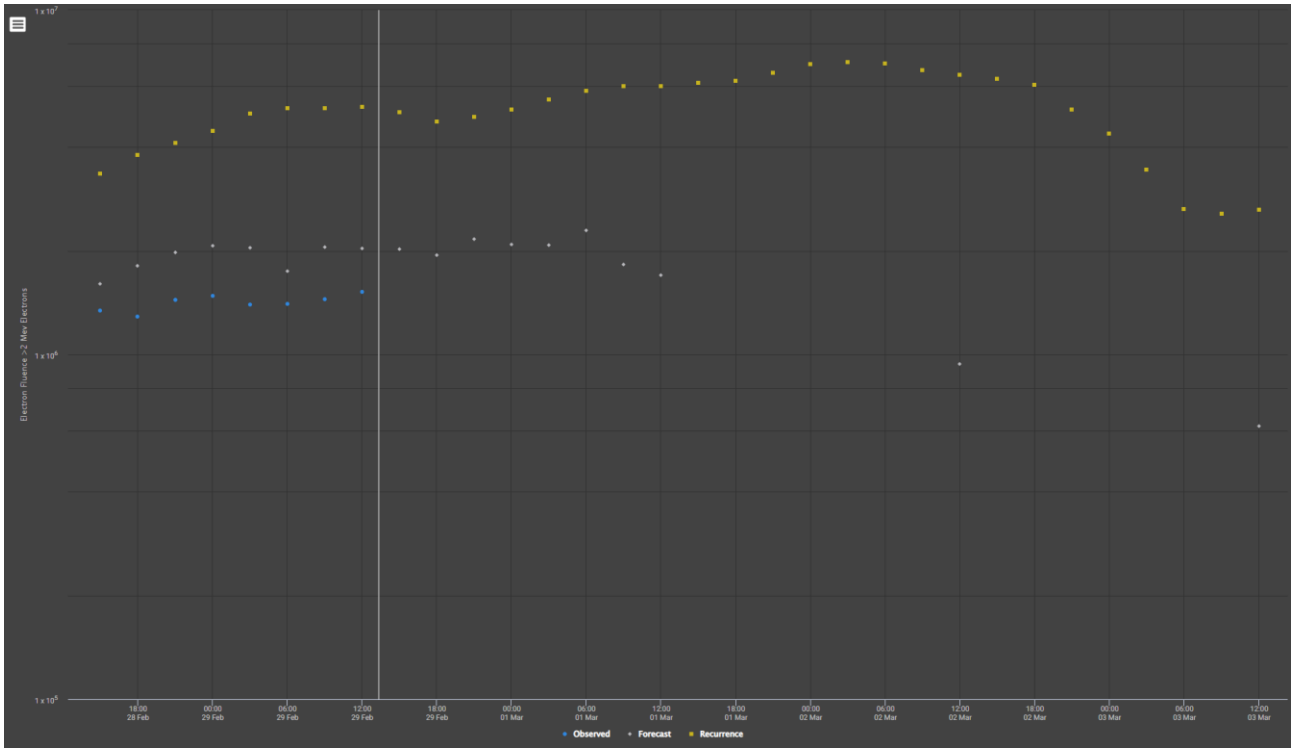
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at background levels. Recent fast wind enhancement from CH01/- and potential minor enhancement from CH03/- are both relatively weak affairs, despite the observed G1/Minor Storm on 27 Feb, and the GOES-16 electron flux is expected to persist at background levels. No further notable enhancements are forecast.

The associated 24 hour fluence is expected to stay well below the Active (1e8 integrated pfu) threshold, with REFM currently thought to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: latest MOSWOC REFM model output



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